

Remarks

For the reasons stated herein, Applicants request that the Examiner reconsider the rejection set forth in the final Office Action. If, after reviewing this paper, the Examiner remains unconvinced as to Applicants' position with respect to the applied art, Applicants' undersigned representative requests that the Examiner schedule a telephone interview with Applicants' representative to further discuss the rejection stated in the final Office Action and the issues raised hereinbelow with respect thereto.

In the Office Action, all pending claims (i.e., claims 1-24) were rejected under 35 U.S.C. §103(a) as being unpatentable over Boland et al. (U.S. Patent No. 5,826,079; hereinafter Boland) in view of Jones et al. (U.S. Patent No. 5,812,844; hereinafter Jones). This rejection is respectfully, but most strenuously, traversed and reconsideration thereof is requested.

Applicants request reconsideration and withdrawal of the obviousness rejection on at least the following grounds:

- (1) The Office Action and the purported combination of Boland and Jones fails to state a *prima facie* case of obviousness against Applicants' claimed invention;
- (2) The Office Action has misinterpreted the teachings of Boland, thus voiding the basis for the rejection;
- (3) The documents themselves lack any teaching, suggestion or incentive for their further modification as necessary to achieve Applicants' recited invention;
- (4) The purported rationale for combining Jones and Boland stated in the Office Action is deficient; and
- (5) The Boland patent and Applicants' recited invention are fundamentally directed to different problems.

Failure to State a *Prima Facie* Case of Obviousness:

Applicants' invention, in one aspect, is directed to a computer system which includes tasks potentially contending for a latch (see claim 1). **Each task includes:**

a probability determining component to dynamically estimate the probability that the task will successfully acquire the latch; and

a suspending component to place the task in a suspended state for a defined sleep time where the estimated probability is below a predetermined threshold value.

Applicants respectfully submit that numerous aspects of their above-summarized invention are not taught or suggested by Boland and Jones, either alone or in combination.

Boland describes a method for improving the execution efficiency of frequently communicating processes utilizing affinity process scheduling by identifying and assigning the frequently communicating processes to the same processor. A sleep/wakeup facility is employed whereby a first process requiring information from a second process is placed into a “sleep” state by the computer system until the second process is able to provide the required information. Upon the second process providing the required information, the computer system awakes the first process so that the first process may continue processing with the required information. To identify frequently communicating processes, the Boland method maintains a record of each “wakeup” request issued by the computer system, the record including: an identification of the process on whose behalf the wakeup request is issued; and an identification of the process to which the wakeup request is issued. The records are periodically examined to determine a count of the number of wakeup requests between pairs of processors. Should the number of wakeup requests between two processors exceed a predetermined threshold, then those two processes are assigned to the same processor. (See Abstract.)

Relative to Applicants’ independent claims, the Office Action cites certain discussion at column 1, lines 59-67, column 2, line 22 & column 3, lines 12-13 of Boland concerning an affinity scheduler. The affinity scheduler in Boland allocates processors to processes and schedules the processes to run based upon the bases of priority and processor availability. The scheduler dynamically detects problems by periodically examining the run queue lengths of each processor and steals processes from processors having run queue lengths significantly greater than the average, system wide run queue length. The records are periodically examined to determine a count of the number of wakeup requests between pairs of processors. Should the number of wakeup requests between two processors exceed a predetermined threshold, those two

processor are assigned to the same processor within the multi-processor computer system for execution.

Applicants respectfully submit that a *prima facie* case of obviousness is not stated in the Office Action in connection with their independent claims for at least two reasons. Assuming, for a moment, that the affinity scheduler in Boland was somehow employing a probability determining component, the resultant system would still not comprise Applicants' invention as presented in their independent claims. Specifically, Applicants' claims recite that **each task includes**: (1) a probability determining component; and (2) a suspending component.

In Applicants' invention, the tasks themselves have the probability determining component and a suspending component integrated therein as part of the task. This advantageously allows each task to execute its logic independently, as opposed to requiring communications with a central process or scheduler to execute the logic. Clearly, the affinity scheduler described by Boland is external to the processes to be executed and would not equate to Applicants' tasks, which are potentially contending for a latch and have the recited probability determining component and suspending components integrated therein.

The Office Action fails to address the above-noted deficiencies of Boland and Jones when applied against the independent claims presented. Neither patent describes the inclusion of components in the processes described therein which accomplish analogous functions to those recited by Applicants. In this regard, Applicants note that an "obviousness" determination requires an evaluation of whether the prior art taken as a whole would suggest the claimed invention taken as a whole to one of ordinary skill in the art. In evaluating claimed subject matter as a whole, the Federal Circuit has expressly mandated that functional claim language be considered in evaluating a claim relative to the prior art. Applicants respectfully submit that the application of these standards to the independent claims presented leads to the conclusion that the recited subject matter would not have been obvious to one of ordinary skill in the art based on the applied patents.

Again, Applicants' independent claims recite that **each task includes at least two components**, that is, a probability determining component and a suspending component. Neither Boland nor Jones teach tasks having the same or similar components. For at least this reason,

Applicants respectfully request reconsideration and withdrawal of the obviousness rejection to the independent claims based on the applied art.

Still further, Applicants respectfully submit that a *prima facie* case of obviousness is not stated in the Office Action in connection with their independent claims since the independent claims recite that each task includes a probability determining component to dynamically estimate **the probability that the task will successfully acquire the latch**. Again, assuming, for a moment, that the affinity scheduler in Boland were somehow employing a probability determining component, the resultant system still does not determine an affinity for a particular process to acquire a latch. The Office Action does not specifically address this point, but rather, generally references column 1, lines 59-67, column 2, lines 1-22, and column 3, lines 12-13. For convenience, this material is repeated below:

In order to minimize process migration between process, the process scheduler can be enhanced to give individual processes “affinity” to a particular processor. One such method of scheduling processes is disclosed in U.S. Pat. No. 5,185,861 to Valencia, issued Feb. 9, 1993, and entitled “Cache Affinity Scheduler”. In that patent, an affinity scheduler for a multi-processor computer system is disclosed. The affinity scheduler allocates processors to processes and schedules the processes to run based upon the bases of priority and processor availability. The scheduler uses the estimated amount of cache context to decide which run queue a process is to be enqueued. U.S. Pat. No. 5,185,861 is hereby incorporated by reference.

In order to ensure a uniform distribution of processes to processor’s, traditional affinity schedulers utilize three load-balancing techniques:

1. New processes are placed on a global run queue. Since all processor’s periodically check the global queue, the processor that are more idle will tend to check the global queue more often, achieving load balancing for new processes.
2. Processes that have not run on a give processor for some period of time are “aged” via some tunable metric (such as the number of context switches or clock ticks since the time the process was last run). When the age of a process exceeds some threshold, the process loses its affinity to that processor, since it is assumed that its working set of text and data have been replaced by those of other processes. In this case, the process is put back on the global queue when it is ready to run again.

3. Dynamic loading problems are detected by periodically examining the run queue lengths of each processor and stealing processes from processors having run queue length.

The utilization of affinity process scheduler wherein processes are assigned to processors as described above may complicate efforts to eliminate the locking and cache inefficiencies associated with a sleep/wakeup facility. A method for reducing locking and cache inefficiencies in an SMP system employing a sleep/wakeup facility together with an affinity process scheduler is desired. (See column 1, line 59 through column 2, line 22 of Boland.)

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In the described embodiment, the method of the present invention maintains a record of each “wakeup” request issued by the computer system, the record including: an identification of the process on whose behalf said wakeup request is issued; and an identification of the process to which said wakeup request is issued. The records are periodically examined to determine a count of the number of wakeup requests between pairs of processors. Should the number of wakeup requests between two processors exceed a predetermined threshold, those two processors are assigned to the same processor within the multi-processor computer system for execution. (See column 3, lines 7-18 of Boland.)

A careful reading of the cited material in Boland fails to uncover any discussion of the affinity given to an individual process, or the affinity scheduler itself relating to acquiring a latch *per se*. The functionality recited by Applicants in the independent claims is that the probability determining component dynamically estimates the probability that the task will successfully acquire the latch. Because the cited lines of Boland wherein affinity is described do not relate to acquiring a latch, it is respectfully submitted that the Office Action fails to state a *prima facie* case of obviousness against Applicants’ independent claims. For this additional reason, reconsideration and withdrawal of the rejection is respectfully requested.

The Office Action Has Misinterpreted the Teachings of Boland:

As noted, the affinity scheduler in Boland allocates processors to processes and schedules the processes to run based upon the basis of priority and processor availability. Individual processes are given “affinity” to a particular processor, as described at column 2, lines 8-26 of Boland. The Office Action asserts that it is reasonable to interpret the word “affinity” as used in Boland as a measure of probability as recited by Applicants. This conclusion is again respectfully traversed and reconsideration is requested for the reasons set forth below.

Applicants recite in their independent claims a probability determining component to dynamically estimate **the probability that a task will successfully acquire a latch**. In contrast, the affinity scheduler in Boland allocates processors to processes and schedules the processes to run based upon priority and processor availability. These are clearly distinct concepts.

The word “affinity” means a relation or connection to a particular processor, while “probability” is a mathematical determination of a chance an event will occur, for example, that a task will successfully acquire a latch. The concepts of employing probabilities or statistics is simply not taught or suggested by Boland. Further, the affinity scheduler described by Boland does not operate on the principles of probabilities. The affinity scheduler discussed therein operates on the principles of certainty.

Still further, Applicants recite a probability determining component that determines the probability that the task (within which the component resides) will successfully acquire a latch. In Boland, affinity is used in the sense of a measure of likeliness of attraction between two processes. If two processes have a sufficient affinity, i.e., attraction, then the processes are assigned to the same processor in order to facilitate communications between these processes. Thus, the use of affinity in Boland is clearly distinct from the use of probabilities in the present claims because Applicants recite determining probability that the task will successfully acquire the latch, while Boland employs affinity to determine the attractiveness of two processes to a particular processor since the processes involved are closely related.

For the above reasons, Applicants respectfully submit that the Office Action mischaracterizes/misinterprets the teachings of Boland when alleging the obviousness rejection to their independent claims. Boland does not disclose the existence of a probability determining component that dynamically estimates the probability that a given task will successfully acquire a latch. For at least this reason, Applicants respectfully request reconsideration and withdrawal of the obviousness rejection to their independent claims based on the teachings of Boland and Jones.

The Documents Themselves Lack any Teaching, Suggestion or Incentive for their Further Modification as Necessary to Achieve Applicants' Recited Invention:

Without acquiescing to the rationale for combining the documents, Applicants also note that if Jones is combined with Boland as proposed, their recited invention would still not have been taught or suggested by the combination as outlined above. As noted, neither Boland nor Jones describes providing each task potentially contending for a latch with at least two components, that is, a probability determining component and a suspending component. Further, neither patent describes providing such components wherein the probability determining component determines probability that the task will successfully acquire the latch.

Upon a review of the applied patents, there is no teaching, suggestion or incentive for further modification of the combination as would be necessary to achieve Applicants' invention. In this regard, neither patent teaches that tasks contending for a latch include a probability determining component and a suspending component. For example, the affinity scheduler in Boland is external to the processes to be executed, and neither patent teaches or suggests a probability determining component which dynamically estimates probability that a task will successfully acquire a latch, let alone a facility for using such a probability determination to suspend the task for a defined sleep time where the estimated probability is below a threshold value. In Applicants' invention, each task contending for a latch has its own probability determining component and suspend component such that each task executes the logic independently.

The Purported Rationale for Combining Jones and Boland Stated in the Office Action is Deficient:

As noted above, Boland teaches that a first process requiring information from a second process is placed into a "sleep" state by the computer system until the second process is able to provide the required information. The Office Action alleges at page 3 that this teaching of Boland would be modified by one skilled in the art to say that a first process is placed into a "sleep" state by the computer system for a predetermined time interval because, allegedly, this would improve Boland's affinity process scheduling system by allowing it to know exactly when the threads are awoken from sleeping. This rationale is respectfully, but not strenuously,

traversed. Clearly, efficiency of the resultant Jones and Boland system proposed in the Office Action would be significantly worse than the Boland system by itself. If a first process requires information from a second process, highest efficiency is achieved by awaking the first process once the information is available. To implement a system such as recited in the Office Action would degrade processing since the defined sleep time interval would have no relation to the amount of time required by the second process to complete its processing. Clearly, the most efficient Boland system is to maintain the first process in a sleep mode until the information that the first process requires becomes available. Conceivably, the defined sleep time in Jones could be too small, in which case the first process would continually be awoken, determine that the second process still has not completed processing, and then be returned to sleep mode. Conversely, if the defined interval is too long, then the first process is awakened well after the second process has completed processing, meaning that the overall efficiency of the computer system has been degraded.

For at least the above reasons, Applicants respectfully submit that one of ordinary skill in the art would not have combined the teachings of Jones with those of Boland as outlined in the Office Action.

The Present Invention and Boland Patent are Addressing Different Problems:

In Applicants' invention, multiple tasks are attempting to acquire a latch. Thus, the problem addressed by the present invention is ordering of the tasks where perhaps hundreds of tasks may all be competing for a single latch to a shared resource. If all tasks attempt to acquire the latch at the same instance in time, processing suffers. Thus, the present invention is a facility within each task that is contending for the latch for that task to dynamically estimate the probability that the task will acquire the latch.

In contrast, Boland is an affinity scheduler attempting to evaluate the affinity between two processes. If two processes frequently communicate with one another, then the processes are assigned to the same processor. Thus, the Boland patent is attempting to identify pairs of processes that frequently communicate, and once determined, directs the external affinity scheduler to assign those processes to the same processor. This is a fundamentally different problem than that addressed by the present invention.

For this additional reason, Applicants respectfully submit that one of ordinary skill in the art would not have read Boland as somehow suggesting or implying the above-noted deficiencies thereof when applied against Applicants' independent claims.

For all the above reasons, Applicants respectfully submit that the independent claims patentably distinguish over the teachings of Boland and Jones. Reconsideration and withdrawal of the obviousness rejection based thereon are therefore respectfully requested.

The dependent claims are believed allowable for the same reasons as the independent claims, as well as for their own additional features. For example, claims 4, 12 & 20 specify that the suspending component of each task adjusts the defined sleep time in accordance with changes in the estimated probability that the task will successfully acquire the latch. No similar functionality is taught or suggested by Boland and/or Jones.

For at least the above reasons, Applicants' respectfully submit that all claims are in condition for allowance, and such as is respectfully requested.

If a telephone conference would be of assistance in advancing prosecution of the subject application, Applicants' undersigned attorney invites the Examiner to telephone him at the number provided.

Respectfully submitted,



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